

What is claimed is:

- 1 1. A molding die for molding glass, comprising:
2 a substrate;
3 a first intermediate layer of Ni-containing Ir-Re alloy
4 overlying the substrate, with Ni concentration
5 decreasing with distance from the substrate/first
6 intermediate layer interface;
7 a second intermediate layer of metal-containing Ir-Re
8 alloy overlying the first intermediate layer, the
9 metal comprising Cr, Ta, Ti, or Ti-Cr alloy, in
10 concentration increasing with distance from the
11 first intermediate layer/second intermediate
12 layer interface; and
13 a passivation film overlying the second intermediate
14 layer.
- 1 2. The molding die as claimed in claim 1, wherein the
2 substrate comprises tungsten carbide.
- 1 3. The molding die as claimed in claim 1, wherein
2 maximum Ni concentration of the first intermediate layer is
3 between 20 and 30 at%.
- 1 4. The molding die as claimed in claim 1, wherein
2 minimum Ni concentration of the first intermediate layer is
3 between 5 and 10 at%.
- 1 5. The molding die as claimed in claim 1, wherein
2 atomic ratio of Ir to Re of the first intermediate layer is
3 between 99 to 1 and 70 to 30.

1 6. The molding die as claimed in claim 1, wherein
2 atomic ratio of Ir to Re of the first intermediate layer is
3 between 99 to 1 and 90 to 10.

1 7. The molding die as claimed in claim 1, wherein the
2 thickness of first intermediate layer is about 0.1 to 0.3 μ m.

1 8. The molding die as claimed in claim 1, wherein
2 maximum Cr concentration of the second intermediate layer is
3 between 40 and 50 at%.

1 9. The molding die as claimed in claim 1, wherein Cr
2 concentration of the second intermediate layer is at least
3 higher than 0 at%.

1 10. The molding die as claimed in claim 1, wherein
2 maximum Ta concentration of the second intermediate layer is
3 between 20 and 25 at%.

1 11. The molding die as claimed in claim 1, wherein Ta
2 concentration of the second intermediate layer is at least
3 higher than 0 at%.

1 12. The molding die as claimed in claim 11, wherein
2 maximum Ti concentration of the second intermediate layer is
3 between 20 and 25 at%.

1 13. The molding die as claimed in claim 1, wherein Ti
2 concentration of the second intermediate layer is at least
3 higher than 0 at%.

1 14. The molding die as claimed in claim 1, wherein
2 maximum Ti-Cr alloy concentration of the second intermediate
3 layer is between 30 and 38 at%.

1 15. The molding die as claimed in claim 1, wherein Ti-
2 Cr alloy concentration of the second intermediate layer is
3 at least higher than 0 at%.

1 16. The molding die as claimed in claim 1, wherein
2 atomic ratio of Ir to Re of the second intermediate layer is
3 between 99 to 1 and 70 to 30.

1 17. The molding die as claimed in claim 1, wherein
2 atomic ratio of Ir to Re of the second intermediate layer is
3 between 99 to 1 and 90 to 10.

1 18. The molding die as claimed in claim 1, wherein the
2 thickness of second intermediate layer is about 0.1 to
3 0.3 μ m.

1 19. The molding die as claimed in claim 1, wherein the
2 passivation film comprises nitride-containing Ir-Re alloy.

1 20. The molding die as claimed in claim 19, wherein
2 atomic ratio of Ir to Re of the passivation film is between
3 99 to 1 and 70 to 30.

1 21. The molding die as claimed in claim 19, wherein
2 atomic ratio of Ir to Re of the passivation film is between
3 99 to 1 and 90 to 10.

1 22. The molding die as claimed in claim 1, wherein the
2 thickness of passivation film is about 0.5 to 2 μ m.

1 23. The molding die as claimed in claim 19, wherein
2 the nitride is chromium nitride, tantalum nitride, titanium
3 nitride, or titanium chromium nitride.

1 24. The molding die as claimed in claim 23, wherein
2 the nitride is chromium nitride when the metal is Cr.

1 25. The molding die as claimed in claim 23, wherein
2 the nitride is tantalum nitride when the metal is Ta.

1 26. The molding die as claimed in claim 23, wherein
2 the nitride is titanium nitride when the metal is Ti.

1 27. The molding die as claimed in claim 23, wherein
2 the nitride is titanium chromium nitride when the metal is
3 Ti-Cr alloy.

1 28. The molding die as claimed in claim 1, wherein the
2 passivation film comprises a molding surface.

1 29. A molding die for molding glass, comprising:
2 a substrate;
3 a first intermediate layer of Ni-containing Ir-Re alloy
4 overlying the substrate, with Ni concentration
5 decreasing with distance from the substrate/first
6 intermediate layer interface;
7 an intermediate buffer layer of Ir-Re alloy overlying
8 the substrate;
9 a second intermediate layer of metal-containing Ir-Re
10 alloy overlying the intermediate buffer layer,
11 the metal comprising Cr, Ta, Ti, or Ti-Cr alloy,
12 in concentration increasing with distance from

13 the intermediate buffer layer/second intermediate
14 layer interface; and
15 a passivation film overlying the second intermediate
16 layer.

1 30. The molding die as claimed in claim 29, wherein
2 the substrate is tungsten carbide.

1 31. The molding die as claimed in claim 29, wherein
2 maximum Ni concentration of the first intermediate layer is
3 between 20 and 30 at%.

1 32. The molding die as claimed in claim 29, wherein
2 minimum Ni concentration of the first intermediate layer is
3 between 5 and 10 at%.

1 33. The molding die as claimed in claim 29, wherein
2 atomic ratio of Ir to Re of the first intermediate layer is
3 between 99 to 1 and 70 to 30.

1 34. The molding die as claimed in claim 29, wherein
2 atomic ratio of Ir to Re of the first intermediate layer is
3 between 99 to 1 and 90 to 10.

1 35. The molding die as claimed in claim 29, wherein
2 the thickness of first intermediate layer is about 0.1 to
3 0.3 μ m.

1 36. The molding die as claimed in claim 29, wherein
2 maximum Cr concentration of the second intermediate layer is
3 between 40 and 50 at%.

1 37. The molding die as claimed in claim 29, wherein Cr
2 concentration of the second intermediate layer is at least
3 higher than 0 at%.

1 38. The molding die as claimed in claim 29, wherein
2 maximum Ta concentration of the second intermediate layer is
3 between 20 and 25 at%.

1 39. The molding die as claimed in claim 29, wherein Ta
2 concentration of the second intermediate layer is at least
3 higher than 0 at%.

1 40. The molding die as claimed in claim 29, wherein
2 maximum Ti concentration of the second intermediate layer is
3 between 20 and 25 at%.

1 41. The molding die as claimed in claim 29, wherein Ti
2 concentration of the second intermediate layer is at least
3 higher than 0 at%.

1 42. The molding die as claimed in claim 29, wherein
2 maximum Ti-Cr alloy concentration of the second intermediate
3 layer is between 30 and 38 at%.

1 43. The molding die as claimed in claim 29, wherein
2 Ti-Cr alloy concentration of the second intermediate layer
3 is at least higher than 0 at%.

1 44. The molding die as claimed in claim 29, wherein
2 atomic ratio of Ir to Re of the second intermediate layer is
3 between 99 to 1 and 70 to 30.

1 45. The molding die as claimed in claim 29, wherein
2 atomic ratio of Ir to Re of the second intermediate layer is
3 between 99 to 1 and 90 to 10.

1 46. The molding die as claimed in claim 29, wherein
2 the thickness second intermediate layer is about 0.1 to
3 0.3 μ m.

1 47. The molding die as claimed in claim 29, wherein
2 atomic ratio of Ir to Re of the intermediate buffer layer is
3 between 99 to 1 and 70 to 30.

1 48. The molding die as claimed in claim 29, wherein
2 atomic ratio of Ir to Re of the intermediate buffer layer is
3 between 99 to 1 and 90 to 10.

1 49. The molding die as claimed in claim 29, wherein
2 the thickness of intermediate buffer layer is about 0.01 to
3 0.1 μ m.

1 50. The molding die as claimed in claim 29, wherein
2 the passivation film is nitride-containing Ir-Re alloy.

1 51. The molding die as claimed in claim 50, wherein
2 atomic ratio of Ir to Re of the passivation film is between
3 99 to 1 and 70 to 30.

1 52. The molding die as claimed in claim 50, wherein
2 atomic ratio of Ir to Re of the passivation film is between
3 99 to 1 and 90 to 10.

1 53. The molding die as claimed in claim 29, wherein
2 the thickness of passivation film is about 0.5 to 2 μ m.

1 54. The molding die as claimed in claim 50, wherein
2 the nitride is chromium nitride, tantalum nitride, titanium
3 nitride, or titanium chromium nitride.

1 55. The molding die as claimed in claim 54, wherein
2 the nitride is chromium nitride when the metal is Cr.

1 56. The molding die as claimed in claim 54, wherein
2 the nitride is tantalum nitride when the metal is Ta.

1 57. The molding die as claimed in claim 54, wherein
2 the nitride is titanium nitride when the metal is Ti.

1 58. The molding die as claimed in claim 54, wherein
2 the nitride is titanium chromium nitride when the metal is
3 Ti-Cr alloy.

1 59. The molding die as claimed in claim 29, wherein
2 the passivation film comprises a molding surface.